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A prospective parallel study of patients receiving total parenteral nutrition (TPN) was undertaken to identify characteristics of TPN solution use and waste. Thirty consecutive patients receiving TPN by order of the primary clinical service (control group) were compared with 25 consecutive patients receiving TPN under the supervision and monitoring of the Nutritional Support Service (study group). The patients were evenly divided between medical and surgical problems, with 53% of the control group being surgical patients compared to 56% of the study group. There were 136 L of TPN or 4.5 L/patient discarded in the control group compared to 65 L or 2.6 L/patient discarded in the study group. This wastage expressed as a percentage is 13.2% for the control group and 7.1% for the study group. Pharmacist involvement in TPN monitoring and supervision was associated with a 46% decrease in solution waste. The data from this study suggest that pharmacist involvement in TPN monitoring and supervision may be cost-effective. (Henry Ford Hosp Med J 1986;34:99-100)

Parenteral nutrition solutions constitute a major component of the cost of total parenteral nutrition (TPN) therapy (1). As an integral member of the nutritional support team, the pharmacist is uniquely qualified to assist in maximizing the effective use and minimizing the waste of TPN solutions. The impact of pharmacist monitoring of TPN usage to help decrease waste is not well known (2,3). This prospective study was undertaken to determine the effect of pharmacists' monitoring of TPN solution use.

Materials and Methods

Beginning in July 1982, during a three-month period, 30 consecutive patients receiving TPN by order of the primary clinical service (control group) were identified and compared to 25 consecutive patients receiving TPN under supervision and monitoring of the nutritional support team (study group). These two groups were compared in terms of TPN solution use and waste.

The TPN team pharmacist actively participated in planning and monitoring therapy for the 25 study group patients. The pharmacist was attentive to activities which would promote effective ordering and use of TPN solutions while decreasing the number of solutions that were prepared but not administered. Examples of these activities include the following:

1. Physicians were encouraged to correct electrolyte imbalances by adjusting peripheral intravenous (IV) therapy or enteral therapy rather than changing already prepared TPN solutions.
2. Physicians were encouraged to alter future TPN solution formulations with the next solution to be infused.
3. The inpatient pharmacy was promptly notified of solution changes to decrease unnecessary solution preparation.
4. Clinical and laboratory data were monitored to anticipate required changes in formulation.
5. Alternatives to parenteral nutrition were suggested when appropriate.

Results

The results of this prospective study are summarized in the Table. Demographically, the control and study group patients were similar. Both groups also had similar courses of TPN therapy.

The Table illustrates substantial differences between the two groups in liters of TPN solution discarded during therapy. In the control group, 136 L of TPN or 4.5 L/patient were discarded compared to 65 L of TPN or 2.6 L/patient in the study group. The percentage waste (total liters wasted divided by total liters infused) was 13.2% for the control group and 7.1% for the study group. Of the parenteral nutrition regimens prescribed, ten of the 30 patients (33%) in the control group utilized peripheral hyperalimentation. In the study group, three of the 25 patients (12%) utilized peripheral hyperalimentation, which was a 21% reduction in peripheral hyperalimentation use.

Wastage of TPN solutions in primary service administration (control group) was high, 4.5 L of TPN solution per patient. Expressed as dollars, based on a manufacturer's list price of $46.71/L, this loss averaged $210.20/patient in solution costs alone. In the study group only 2.6 L/patient of TPN solution were wasted. The difference between the control and study groups amounted to $93.43/patient.

Discussion

Nutritional support is expensive, particularly in the form of parenteral nutrition. In 1982, approximately 450 Henry Ford Hospital patients received this form of therapy at an average

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Table
Summary Comparison of Control and Study Groups (Demographics and TPN Use and Waste)

	Control Group	Study Group
Number of patients	30	25
Patient age		
Average years (range)	60.8 (22 to 92)	50.6 (15 to 75)
Sex: male/female	21/9	17/8
Primary service (No. of patients)		
Medicine	14	11
Surgery	16	14
Duration of TPN therapy		
Average (days)	13.1	13.4
Range	5 to 34	6 to 24
Liters of TPN infused		
Total	1,029	920
Average/patient	34.3	36.8
Range	12 to 90	16 to 60
Liters wasted		
Total	136	65
Average/patient	4.5	2.6
% Wastage (Total unused/total infused)	13.2%	7.1%
% Peripheral hyperalimentation	33.3%	12%

annual retail cost of $815,000 per year. The estimate that approximately $1 billion were spent in the United States in 1985 for solutions and equipment illustrates this costly therapeutic modality (4).

Since most cases referred to the nutritional support team are complicated and beyond their DRG cash allotment, nutritional support teams are facing an economic pressure to disband. The argument for keeping the team relies on the proven safety and efficacy of nutritional support when managed according to protocol. Complications and waste associated with overfeeding, underfeeding, or inappropriate feeding may result in cost increases that far outweigh the cost of the team (5).

In this study pharmacist involvement in TPN monitoring and supervision was associated with a 46% decrease in central venous solution waste compared to the control group. This reduction in solution waste when calculated on 450 patients amounts to $79,874 per year. This improved efficiency of solution use was accomplished with careful attention to needed changes in therapy and a thorough understanding of formulation schedules in the pharmacy.

The 21% reduction of peripheral hyperalimentation use was accomplished in two ways: 1) by using the gastrointestinal tract when possible with tube feedings and/or oral supplements rather than peripheral therapy, or 2) by instituting central venous hyperalimentation if the duration of therapy warranted a prolonged course of IV nutritional support longer than ten days. The cost difference in central venous hyperalimentation and peripheral hyperalimentation is approximately $34.68 per day. This additional cost, applied to 33% of 450 patients, amounts to $67,175 per year. The peripheral venous route is a more expensive mode of therapy because of the extensive use of IV fat emulsions as a primary caloric source. Based on retail costs of hyperalimentation solutions, pharmacist intervention in these few areas could reduce costs by approximately $122,700 per year. Thus, the pharmacist's role in this area of therapeutic management is beneficial on both clinical and economic grounds (6-8).

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